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NOTES ON THE GEOLOGICAL SECTION OF IOWA

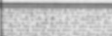
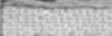
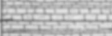
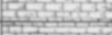
SAMUEL CALVIN
Iowa City, Ia.

The columnar section is not drawn to scale. The approximate average thickness is indicated in the appropriate column.

The Sioux quartzite occupies only a few acres in the northwest corner of the state, and in this locality it is Cretaceous sediments which are found, in place, abutting against it. That it is pre-Cambrian in age admits of no doubt, and that it is the equivalent of the Baraboo quartzite of Wisconsin is equally certain. The 25 feet exposed in Iowa is only a small part of the thickness of this formation.

The Cambrian sandstones are exposed by the erosion of the river valleys in the northeastern part of the state. The basal contact with the Algonkian quartzites is not seen in Iowa; a thickness of fully 700 feet of this formation lies below the level of the Mississippi River at Lansing and New Albin. This sandstone has been referred to the Upper Cambrian, or Potsdam series, in the geological reports of Iowa and Wisconsin. The special formation name, St. Croix, and the names applied to the smaller divisions, have been adopted from the reports on the geology of Minnesota.

Lower Magnesian.—This term is retained tentatively for the sediments lying between the top of the Cambrian, the Jordan sandstone, and the very consistent geologic unit which has been universally recognized under the name of the St. Peter sandstone. The New Richmond sandstone, when present, divides the Lower Mag-

System	Series Name	Formation Name	Columnar Section	Thickness in Feet	Character of Rocks	
Quaternary	Pleistocene	Wisconsin		0-30	Boulder clay, pale yellow, very calcareous.	
		Perian			Soil bands.	
		Iowan		0-30	Boulder clay, yellow, with very large boulders.	
		Sangamon			Soil, peat and forest beds.	
		Illinoian		0-100	Boulder clay, yellow.	
		Yarmouth			Soil, peat and forest beds.	
		Kansan		0-400	Boulder clay, blue, pitted with intercalated streaks & pockets of sand & gravel.	
		Allenian		0-40	Soil & forest beds, soil bands, aqueous gravels.	
Cretaceous	Upper Cretaceous	Pre-Kansan		0-20	Boulder clays, dark, friable.	
		Colorado		150	Shales with soft limestones, in places cherty.	
Tertiary		Dakota		100	Sandstones.	
		Gypsum Series	Red Beds		20	Red shales and sandstones.
		Gypsum		20	Gypsum.	
		Carboniferous	Pennsylvanian	Missourian		600
Des Moines				750	Shales and sandstones with some beds of limestone.	
Mississippian	St. Louis			200	Limestone, sandstone, & marly shales.	
	Osage or Augusta			265	Locally crinoidal limestone, with heavy bands of chert, some shale.	
	Kinderhook			120	Shale, sandstone and limestone, limestone in places white.	
Devonian	Neo-Devonian	State Quarry		(40)	Limestone, mostly brachiopod remains.	
		Lime Creek		(150)	Mostly shales (heavily developed features) (see fig. accompanying text for details).	
	Meso-Devonian	Sweetland Creek		(20)	Shale.	
		Cedar Valley		100	Limestones, shaly limestones, some dolomite in the northern counties.	
Silurian	Niagara	Wapsipipicon		60-75	Limestone, shales, & shaly limestones.	
		Gower		120	Dolomite, not very fossiliferous, in Chert phase extremely cross-bedded.	
Ordovician	Trenton	Hopkinton		220	Dolomite, very fossiliferous, in place.	
		Maquoketa		200	Shale, shaly limestones, and, locally, beds of dolomite.	
		Galena		340	Dolomite in places, in places unaltered limestones.	
	Canadian	Platteville		90	Marly shales and limestones.	
		St. Peter		100	Sandstone.	
		Lower Magnesian	Shakopee		80	Dolomite.
			New Richmond		20	Sandstone.
Cambrian	Potsdam	Onondaga		150	Dolomite.	
		Jordan		100	Coarse sandstone.	
		St. Lawrence		50	Dolomite, more or less arenaceous.	
Algonkian	Huronian	Dresbach		150	Sandstone, with bands of glauconite.	
		Siuex Quartzite		25	Quartzite.	
— Special Diagram —			Illustrating Devonian Overlap.			
			In places these two formations follow each other conformably, but in the northern section, owing to subsidence, the Dev overlaps on eroded Niagara & Maquoketa.			

nesian of Owen into three units, here named respectively the Oneota, New Richmond, and Shakopee. In the earlier reports of the Iowa Survey the term "Oneota" was used as the full equivalent of the Lower Magnesian of Owen.

The St. Peter sandstone needs little comment further than to say that McGee, in his *Pleistocene History of Northeastern Iowa*, extended the application of the term downward so as to make it include the Shakopee and New Richmond of the Lower Magnesian stage. It was assumed that the two sandstones are related, and the intervening Shakopee limestone is only an incident. Apart from the fact that they are made of quartz grains, the two sandstones have nothing in common. The New Richmond lies in thin beds; the surface of the beds is often ripple-marked; the individual grains, in the most perfect way imaginable, show secondary enlargement; some parts of the formation have been converted into a fair quality of quartzite. None of these things characterize the St. Peter.

The Platteville and Galena limestones.—The confusion which has arisen in connection with the use of the terms "Trenton" and "Galena" as applied to certain Ordovician limestones of the mid-western states, and the probable causes of such confusion, are discussed in the "Geology of Dubuque County," in Volume X of the *Iowa Geological Reports*. The assemblage of strata covered by the two names conjoined is divided by a persistent band of shale and shaly limestone carrying *Orthis subaequata* and *O. tricenaria* of Conrad as characteristic fossils. This band has been called the "Green Shales" in some Minnesota and Iowa reports. All the beds above the "Green Shales" are dolomitic at Dubuque, and, so far as concerns this locality, they have been consistently known as the Galena limestone ever since the publication of the report on the *Geology of Iowa* by James Hall in 1858. In localities where these beds are unaltered limestones, they have usually been spoken of as Trenton. Lithology, and not stratigraphy, was the basis of the classification. It is now proposed to use the term "Galena" for all the strata above the "Green Shales," whether they are dolomitic, as at Dubuque, or are non-dolomitic, as along the river at and above Decorah. Bain's name, "Platteville," is acceptable for the beds below the top of the "Green Shales."

The Maquoketa shales were so named by White in his report on the *Geology of Iowa*, published in 1870. The beds are, in part only, the equivalent of the Cincinnati shales of Meek and Worthen, of the Hudson River shales of the New York geologists.

The Niagara limestone.—Lithologically, the Niagara series of Iowa is wholly unlike that of New York. There are no sandstones, no shales, practically no unaltered limestones. In the mid-west the Silurian is represented by a great body of dolomite in which there is more or less commingling of the Clinton and Niagara faunas of the region farther east. In some cases a number of life zones may be recognized. *Syringopora tenella* characterizes one of these; *Pentamerus oblongus*, another; another has *Caryocrinus*, *Eucalyptocrinus*, and related forms as diagnostic types; and others, like that carrying *Dinobolus Conradi*, are marked by still different species. But these zones are not well set off one from the other, and in many localities there is more or less of intermingling of forms from adjacent zones. The lower part of the Niagara limestone, including the zones between the base of the formation and the top of the Pentamerus-bearing beds, is quite distinct from the upper portion which includes what have been called the Le Claire and the Anamosa limestones. In the earlier volumes of the current series of *Iowa Reports* the lower phase was designated the Delaware stage, and the upper has been called by Norton the Gower stage. The term "Delaware," however, as the name of a geological unit, was used by Orton for a phase of the Ohio Devonian as early as 1878, and it is proposed in the Winneskie County report, now in press, to use "Hopkinton" in place of the preoccupied term "Delaware" for the lower phase of the western Niagara. All the characteristics of this stage are well displayed in the quarries and ravines within a radius of two or three miles around Hopkinton in Delaware County, Iowa.

The Devonian system.—The Devonian is represented in Iowa by an assemblage of sediments carrying characteristic Devonian faunas. It is not possible, however, definitely to correlate any part of the western Devonian with any part of the sediments referred to the same system in New York. There is certainly nothing west of the Mississippi which can be said to represent the Helderberg or Oris-

kany of the East, and the New York Corniferous, or Onondago, is but doubtfully indicated by a few species. The faunal relations of our Devonian, so far as it is possible to recognize such relations, are with the divisions generally known as Hamilton and Chemung. The conditions of sedimentation were different in the two areas, mechanical sediments and turbid waters prevailing in one, clear seas and organic deposits characterizing the other; geographically the basins were separate; a very large proportion of the species are quite distinct and are useless for purposes of correlation. Of the species which are common the order in which they arrived in the respective basins is not the same, some of the upper Devonian forms of New York appearing early in Iowa, while some of the earlier ones came late. In a general way, therefore, but not in any way definite or specific, the Middle and Upper Devonian may be recognized; but not even in the most general way can we point to anything corresponding to the Lower Devonian of the New York section. Indeed, the remarkable lung fish, *Dipterus*, which elsewhere is found only in the Upper Devonian, occurs in Iowa in formations which have been tentatively referred to both the middle and upper divisions of this system. The system has been divided in Iowa on the basis of a marked unconformity; faunally the two divisions are not very distinct. The intimate faunal relations between the Independence shales, near the base of our Devonian, and the Lime Creek shales, above the unconformity near the top, are noted in the reports on Cerro Gordo and Buchanan Counties. The three units referred to the Upper Devonian—the Sweetland Creek shales, Lime Creek shales, and State Quarry limestone—do not lie one above the other, but each is locally developed and lies unconformably on the Cedar Valley limestones.

In Cedar, Linn, and Scott Counties the Devonian follows the Silurian conformably, but in the northern counties, Howard, Winneshie, and Fayette, there is a record of subsidence due to crustal warping after the Devonian was fairly well advanced, and the rocks of this later system overlap the whole Niagara, and, in the counties named, their eastern edge rests on deeply eroded Maquoketa. An attempt is made to show these relations in the special diagram at the foot of the columnar section sheet.

The Lower Carboniferous-Mississippian.—It is possible, indeed probable, that there is an unconformity between the Devonian and Lower Carboniferous, but it has not been positively demonstrated. The actual contact of Devonian and Kinderhook has not been observed. The faunal break is not exceptionally great. The stromatopores, favosites, and most of the other corals characteristic of the Devonian do not appear in the Kinderhook, and the same is true of the Stropheodontas, Strophonellas, and Atrypas; but the Orthothetes, Rhipidomellas, Spirifers, and Cyrtinas have pronounced Devonian relationships. *Productella pyxidata* and *Ptyctodus calceolus*, collected in the Kinderhook of Missouri, furnish other points of affinity between the Kinderhook and Devonian faunas. On the other hand, leaving out *Productella*, the Productidae of the Kinderhook are decidedly Carboniferous, and the fish fauna in general points unmistakably in the same direction. The Burlington limestone and the Keokuk limestones of the earlier geologists of Iowa and Illinois have been united under the term "Osage" or "Augusta." While the two alternative names are not quite synonymous, it is probable that geologists will unite on the term "Osage" for the assemblage of limestones, cherts, and shales under consideration. The St. Louis limestone brings the Iowa Mississippian to a close, and this formation remains as originally defined. When the later Mississippian, the Kaskaskia or Chester, was deposited, the shore lines, so far as now known, lay outside the limits of our state. That the greater part of the Mississippian was characterized by comparatively arid climate is supported by many lines of evidence.

The Pennsylvania series includes the productive coal-measures and presents the usual characteristics, biologic and lithologic, of equivalent deposits in other parts of the world. One of the most pronounced unconformities in the Mississippi valley occurs between the Upper Carboniferous and the older formations. When the Pennsylvanian series began, the shore-line was probably as far south as Arkansas. There are indications that, at that time, Iowa stood higher with respect to tide level than it does at present, and deep erosion trenches were cut in the Silurian, Devonian, and Lower Carboniferous formations. When subsidence allowed the sea to return, it advanced upon a scarred and eroded surface, depositing

shales and sandstones of the Des Moines stage in old drainage channels, and over the surface generally, as far to the northeast as Delaware and Jackson Counties. In the counties last named remnants of coal-measure strata are found in troughs cut in Silurian, and even Ordovician, beds, and similar remnants occur in old river channels cut in the Devonian limestones of Muscatine, Linn, and Johnson Counties. The extreme advance of the coal-measure sea was of comparatively short duration. For the greater part of the Des Moines stage, so far as it is represented in Iowa, the shore-line oscillated back and forth over the area now occupied by the valleys of the Des Moines and the Skunk Rivers. Within this area there are records of numerous slight movements of elevation and subsidence.

The sediments referred to the Missourian stage follow those of the Des Moines without break. The crustal oscillations seem to have been less numerous; the waters were clearer; the climate was less humid; arenaceous deposits are scarce; limestones and shales make up the bulk of the deposits of this stage; progress was made toward the more arid conditions of the Permian.

The Permian.—The gypsum beds in Webster County, together with the associated red shales and sandstones, have been referred by Professor Wilder to the Permian system. By some writers they have been referred to the Triassic, by some to the Cretaceous. These beds contain no fossils, and their stratigraphic relations are such as to lend no aid in determining their exact position in the geological column. They lie unconformably on deposits of the Des Moines stage; in some places they rest on St. Louis limestone, for erosion had cut through the whole thickness of the Des Moines sediments before conditions favoring the deposition of gypsum began.

The Cretaceous system.—The Dakota and Colorado stages of the Upper Cretaceous are represented in northwestern Iowa by a series of sandstones, shales, and chalky limestones. In his report on the *Geology of Iowa*, published in 1870, White divides the Iowa Cretaceous into the "Nishnabotany sandstone," the "Woodbury sandstones and shales," and the "Inoceramus beds." The sandstones along the Nishnabotna River, as well as those at Sergeants Bluff and Sioux City in Woodbury County, together with some

interbedded shales, are referable to the Dakota stage; while the main body of shale and the calcareous *Inoceramus* beds represent the Fort Benton division of the Colorado. It is not certain that there is any true *Niobrara* in Iowa. During the long interval between the Upper Carboniferous and the Upper Cretaceous the surface of Iowa was deeply eroded, and it was on such a surface that the Cretaceous sediments of the state were unconformably deposited. Since the Cretaceous, these sediments, which were comparatively thin at the most and imperfectly consolidated, have been extensively removed by erosion, and now occur in more or less isolated patches. On the geological map of Iowa the Cretaceous is indicated over the entire area upon which it was originally spread.

The Pleistocene deposits.—Iowa was exceptionally fortunate in its location with reference to the movements and marginal limits of the successive ice-invasions of the Glacial epoch. The state, therefore, offers unusual facilities for the study of the relative age and differential characters of the several sheets of drift which make up the great body of mantle rock within the limits of the glaciated area. The succession of the glacial and interglacial stages which have been recognized by members of the national and state surveys is indicated in the columnar section, and the subject will be found discussed in the national and state reports.